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## MOLDED NONWOVEN FABRIC ARTICLES

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This invention relates to new and useful molded non-  
woven fabric articles, and to the process of making. It  
has particularly noteworthy value in the manufacture of  
shaped articles of wearing apparel, such as brassiere cups.

The product is formed by molding to a precise predeter-  
mined shape a fluffy carded web sheet of initially un-  
bonded interlaced mixed staple fibers which includes un-  
drawn (amorphous) polyester fibers as thermoplastic  
binder fibers; the molded sheet being compacted and uni-  
fied into its stable final shape by heating and soft-pressing  
which also effects mutual autogenous interbonding of the  
interlaced thermoplastic polyester fibers at their crossing-  
points so as to provide a fiber-unifying and shape-retain-  
ing network. These amorphous polyester fibers are ren-  
dered crystalline and nontacky during the heating oper-  
ation.

This molding operation is preferably performed by  
shaping the fluffy fibrous sheet over a heated male mold  
and then uniformly pressing and compacting the sheet  
against the mold by use of a non-adhering stretchy rub-  
bery blanket, thereby simultaneously heating the web to  
the requisite extent, after which the molded sheet (which  
is rendered non-adherent during the molding operation)  
is immediately lifted from the heated mold without need  
for cooling. A conformable open-mesh net or gauze can  
if desired be integrally incorporated, by application over  
the fibrous sheet on the mold prior to the pressing step,  
thereby providing reinforcement or a desired appearance  
effect.

All fibers throughout the structure are then coated by  
impregnating with a waterproof resilient polymer latex  
size which interbonds all the fibers at their crossing points  
and imparts the desired body and other physical proper-  
ties to the complete article, but without materially reduc-  
ing its porosity. The product is normally subjected to  
finishing treatments such as washing, bleaching and trim-  
ming, to prepare the final article for use or sale.

The materials and proportions used in manufacturing  
the shaped brassiere cup product are selected so that it  
is highly porous, strong and tough, shape-retaining but  
flexible, non-irritating to the skin, and capable of repeated  
laundering; as more fully explained hereinafter.

The accompanying diagrammatic drawing illustrates the  
invention as applied to the manufacture of a brassiere 1  
having a pair of breast cups 2 and 3 sewn into the harness;  
these cups having been molded from nonwoven carded  
sheets of interlaced staple fibers in the manner briefly  
indicated above, and each having a net 4 integrally com-  
bined in the surface structure as a reinforcement and to  
enhance appearance.

Seamless shaped articles of this invention can be fabri-  
cated so as to embody a combination of features which  
render them eminently suitable for wearing apparel usage.  
They are highly porous and breathable so as to permit of  
the ready passage of air and moisture; and they are mois-  
ture absorptive; resulting in comfort even when worn next  
to the skin and in hot or humid weather. They do not  
abrade or irritate the skin even upon prolonged contact  
and do not cause dermatitic or allergic reactions. There  
is no seam to add bulk and detract from appearance or  
cause discomfort. They feel soft and comfortable against  
the skin. They have sufficient body, strength and resili-

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ence to hold their shape, and to provide comfortable con-  
tour control and support as in the case of brassiere breast  
cups. They can be easily trimmed and readily and durably  
sewed to associative woven fabric elements as in manu-  
facturing complete brassieres. They are durable and the  
initial shape is permanent; the articles not becoming  
stretched out, limp, distorted, wrinkled, ragged or sleazy  
in continued use or on account of repeated laundering  
or dry cleaning. They are initially of attractive appear-  
ance and are easily kept clean and fresh looking by  
home laundering; and they dry rapidly without wrinkling  
or cockling and need no ironing.

The importance of this invention does not reside merely  
in the technical and utility merits of the products, critical  
as these may be to user acceptance and satisfaction.  
Equally important is the fact that these articles can be  
manufactured at a low cost. No weaving or knitting is  
required at any stage. There is no cutting and sewing as  
is required in making conventional brassiere cups. A  
high degree of predetermined shape precision and uni-  
formity are obtainable and on a mass production basis.  
Such uniformity is desirable in the manufacture of bras-  
siere cups; so that anyone who buys brassieres of a given  
style, size and make can depend upon them to have the  
same fit and feel. Such uniformity is not obtainable  
when cups are made by cutting and sewing cloth; particu-  
larly so in respect to inexpensive mass-produced cups.  
The complete process of manufacture from fibers to prod-  
uct is inherently simple and lends itself to high speed pro-  
duction. Although the resultant savings in labor costs and  
equipment charges make inexpensive manufacture possi-  
ble, the products are not shoddy substitutes but are fit for  
use in producing quality merchandise. Thus brassiere  
cups of the present invention can be employed by brassiere  
manufacturers in producing a new and superior type of  
product at a lower cost.

Recognition of the desirability of producing seamless  
three-dimensional wearing apparel articles, especially bras-  
siere cups, by some process of shaping or molding a flat  
fibrous fabric or web, goes back many years and a sub-  
stantial number of patents have described a wide variety  
of proposals. These mostly involved use of special types  
of woven or knitted fabrics although non-woven staple-  
fiber fabrics have also been suggested for products in this  
general category, including brassiere cups. Thus see, for  
instance, U.S. Patents Nos. 2,047,230 (1936), 2,190,545  
(1940), 2,190,807 (1940), 2,285,967 (1942), 2,460,674  
(1949), 2,580,566 (1952), 2,609,539 (1952), 2,616,084  
(1952), 2,760,198 (1956).

However, to the best of our knowledge and belief, none  
of these prior proposals led to any substantial commer-  
cial manufacture or use of seamless shaped brassiere cups.  
Brassiere manufacturers have continued to mainly utilize  
cups formed by cutting and sewing woven fabrics, despite  
the disadvantages of seams and the relatively high labor  
costs involved.

Brassiere cups produced according to the present inven-  
tion have been embodied in complete brassieres which  
have been sufficiently tested and evaluated to indicate  
commercial value as a satisfactory and economical re-  
placement for conventional brassieres, and to verify the  
value of advantageous features attributable to the novel  
cups. The evaluations included usage by a large number  
of women who subjected their test brassieres to daily  
washing and wearing for continuous periods of 30 days or  
more, demonstrating a satisfactory wash-and-wear life.

The particular types of materials utilized in fabricating  
the washable wearing apparel products of this invention  
are of critical importance in respect to successful low-cost  
manufacturing operations as well as in respect to the com-  
bination of characteristics achieved in the end product.